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Occurrence and Impact of Urinary Tract Infections: A Case Study from Najaf, Iraq

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ABSTRACT

Urinary tract infections (UTIs) represent among the most widespread bacterial infections affecting populations throughout the world. The incidence rates of urinary tract infections differ according to the location together with population statistics and economic background of the region. This study investigates the epidemiology, risk factors, and antibiotic resistance patterns of UTIs in Najaf, Iraq, The research findings present vital knowledge points which guide better diagnostic methods and treatment approaches. A total of 500 patients receiving UTI diagnoses during the duration from October 2024 to February 2025 entered the research. The investigators performed bacterial pathogen identification tests on collected samples while running susceptibility tests on the identified pathogens. A higher infection rate appeared in female patients from the study data as their UTI occurrence reached 70% against male patients with 30%. The main pathogen involved in UTIs was Escherichia coli which was identified in 56% of cases among 500 diagnosed individuals, (30% were male and 70% were female). Also, research identifies a rising issue of antibiotic resistance when examining UTI treatment effectiveness for ampicillin and trimethoprim. The results demonstrated that nitrofurantoin with Fosfomycin stood as effective treatment alternatives but sulfamethoxazole showed decreased effectiveness. The high prevalence in female UTI cases alongside pathogen identification calls for new treatment guidelines and better education about infections for the population and stricter antibiotic stewardship in the region.

Keywords: Antibiotic Resistance, Epidemiology, Public Health, Urinary Tract Infection.

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1.INTRODUCTION

UTIs have emerged as a significant public health problem because they infect millions of individuals throughout the world every year. The frequency of UTIs produces substantial health service use as well as heightened medical expenses and illness burden in the population (Foxman 2014). The urinary tract pathogenesis from uropathogenic bacteria leads to clinical manifestations which range between simple cystitis and dangerous pyelonephritis and urosepsis (Flores-Mireles et al., 2015). Epidemiological research demonstrates that women sustain higher UTI rates than men due to their natural anatomy and hormonal changes leading persons to face UTIs once in their lives (Gupta et al., 2017). Men and children and older individuals also develop UTIs especially if they have diabetes or immunosuppression or urinary tract deformities (Magliano et al., 2012). The worldwide volume of UTIs fluctuates due to various elements that include maintaining personal hygiene standards together with the state of healthcare facilities and resistance patterns against antibiotics. India struggles with persistent UTI problems along with other Middle East nations due to poor infection prevention techniques as well as people taking antibiotics without doctor prescriptions and undertracking

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antimicrobial resistance levels (Al-Mayahie, 2013). Multiple drug resistance (MDR) develops due to the current healthcare challenges. Treatment of uropathogens has become more complex because of their increased drug resistance leading to immediate public health action needs (Livermore, 2012). The assessment of UTIs in Najaf Iraq suffers from a lack of sufficient research regarding prevalence rates together with their effects on patients. An assessment of UTI epidemiology within Najaf will analyze demographic patterns along with strain identification and antibiotic resistance examination to develop specific local healthcare approaches and clinical interventions. Identifying these variables creates a fundamental requirement for better patient care and correct antimicrobial stewardship program development.

The rest of this paper is organized as follows: Section 2 provides an in-depth review of recent studies on UTIs, emphasizing key discoveries and existing research gaps. Section 3 outlines the materials and methods used in this study, covering data collection, bacterial identification, and antibiotic susceptibility testing. Section 4 presents the experimental results, examining the prevalence of UTIs, associated risk factors, and patterns of antibiotic resistance. Lastly, Section 5 summarizes the main findings, offers recommendations, and suggests potential directions for future research.

2. LITERATURE REVIEW

Urinary tract infections (UTIs) represent one of the worldwide top bacterial infections which impact approximately millions of patients yearly at considerable health expenditure levels. Uropathogenic Escherichia coli (UPEC) serves as the main cause of UTIs yet Klebsiella pneumoniae, Proteus mirabilis and Enterococcus faecalis and Pseudomonas aeruginosa act as contributing pathogens to the disease burden (Foxman, 2014; Flores-Mireles et al., 2015).

Modern research demonstrates how bacterial virulence factors act in synergy with host susceptibility features and antibiotic resistance mechanisms to generate UTI infections. UPEC uses three main infection mechanism types to anchor itself to tissues and create biofilms while replicating within cells and avoiding host defense elements (Franco et al., 2025; Sgarabotto et al., 2025).

Standard antibiotic treatments for infections have lost their effectiveness because of antimicrobial resistance (AMR) so researchers now explore alternative therapies including new medications and vaccine-based solutions together with immunomodulatory interventions (Livermore, 2012).

The research shows that medical history of UTIs along with anatomical conditions and diabetes and catheter usage and immunocompromised states enhance vulnerability to UTI repeat infections (Gupta et al., 2017; Franco et al., 2025). The urinary tract infection risk depends heavily on the state of microbiota in the gut and vaginal regions since dysbiosis promotes urinary tract bacterial colonization (Al-Mayahie, 2013).

Medical research has evolved its UTI treatment strategy through bacteriophage therapy along with the implementation of probiotics and anti-adhesive mannoside compounds that counteract bacterial adhesion properties (Bilsen et al., 2023). Studies reveal that vaccines focused on UPEC virulence factors function efficiently in medical trials to decrease UTI infection rates according to Flores-Mireles et al. (2015).

The prevention of catheter-associated UTIs (CAUTIs) in hospitalized patients remains problematic so researchers have investigated biofilm-resistant catheter coatings and fibrinogen-blocking agents to stop bacterial colonization (Garcia-Morua et al., 2009).

Franco et al. (2025) conducted research which measured recurrent UTI occurrence rates among female medical college employees in central Kerala who were of reproductive age. The study found a prevalence rate of 22.30%, with significant associations between recurrent UTIs and factors such as daily water intake, urination frequency, and personal hygiene practices.

Sgarabotto et al. (2025) detailed recurrent UTI pathogenesis by studying bacterial persistence together with intracellular bacterial communities (IBCs). The research investigation tested intermittent antibiotic administration which attacks intracellular organisms for treating recurring urinary tract infections.

Bilsen et al. (2023) performed a systematic review to examine the definition consistency for UTIs in present-day scientific studies. A consensus-based reference standard for UTI definitions remains necessary due to the study findings which demonstrated diverse UTI definitions between research studies.

The primary research on urinary tract infections (UTIs) appears in Table 1.

3. MATERIALS AND METHODS

3.1 Study Design and Population

This retrospective cross-sectional study was conducted in hospitals and healthcare centers across Najaf, Iraq, between October 2024 and February 2025. The study included 500 patients (ages 5–75 years) with clinically confirmed urinary tract infections (UTIs), diagnosed based on clinical symptoms and laboratory-confirmed urine cultures. The patient cohort consisted of 350 females (70%) and 150 males (30%), reflecting the higher prevalence of UTIs in women.

Inclusion criteria encompassed patients presenting with UTI symptoms, such as dysuria, increased urinary frequency, and fever, with positive urine cultures indicating bacterial growth. Patients with a history of recent antibiotic use (within the last two weeks) or chronic urinary conditions were excluded to minimize confounding factors.

3.2 Data Collection and Laboratory Analysis

Urine samples were collected under sterile conditions and immediately processed to ensure sample integrity. Each sample underwent a microscopic examination to assess the presence of pus cells, red blood cells, and bacterial cells, followed by culture-based identification of the pathogens.

Bacterial isolation was performed using MacConkey agar, Eosin Methylene Blue (EMB) agar, and blood agar, facilitating the differentiation of Gram-negative and Gram-positive bacteria. Morphological characteristics, such as colony shape and color, were recorded, and biochemical tests (e.g., catalase, oxidase, and urease tests) were performed for precise pathogen identification. The study followed standard microbiological procedures as described by (MacFaddin and Holt et al, 2000).

Table 1: Summary of studies regarding urinary tract infections (UTIs).

Author/Ref./Year	Methods Used	Dataset	Key Findings	Limitations or Gaps
Foxman, 2014	Review	Global epidemiological data	Overview of UTI epidemiology and treatment options	Need for updated data
Flores-Mireles et al., 2015	Review	Literature review	Discussed UTI mechanisms and treatment approaches	Focused mainly on UPEC

Author/Ref./Year	Methods Used	Dataset	Key Findings	Limitations or Gaps
Gupta et al., 2017	Review	International guidelines	Guidelines for treating uncomplicated cystitis and pyelonephritis in women	Limited focus on special populations
Livermore, 2012	Review	Global epidemiological data	Discussed AMR trends and impact on treatment	Data may be outdated
Al-Mayahie, 2013	Cross-sectional study	Iraqi UTI isolates	Prevalence and antimicrobial resistance in Iraqi UTI isolates	Limited geographic scope
Garcia-Morua et al., 2009	Pathogen identification	Mexican population study	Multiple pathogens identified; antibiotic resistance trends analyzed	Lacked longitudinal follow-up
Recent Studies on Epidemiology and Risk Factors				
Franco et al., 2025	Cross-sectional study	417 female staff of reproductive age	Prevalence of recurrent UTIs was 22.30%; significant associations with water intake, urination frequency, and hygiene practices	Limited to a specific population; self-reported data
Pathogenesis and Mechanisms of Infection				
Sgarabotto et al., 2025	Review and proposal	Literature review	Bacterial persistence and IBCs play a key role in recurrent UTIs; proposed pulsed antibiotic therapy	Need for clinical trials to validate proposed treatment
Diagnostic Criteria and Definitions				
Bilsen et al., 2023	Systematic review	47 studies on UTI definitions	Highlighted heterogeneity in UTI definitions; need for consensus-based reference standard	Variability in study designs and definitions

3.3 Antibiotic Susceptibility Testing

The antibiotic resistance profile of the bacterial isolates was assessed using the Kirby-Bauer disk diffusion method, following Clinical and Laboratory Standards Institute (CLSI) guidelines. Standardized bacterial suspensions (0.5 McFarland standard) were inoculated onto Mueller-Hinton agar, and antibiotic disks were placed on the plates. After incubation at 37°C for 18–24 hours, inhibition zone diameters were measured and classified as susceptible, intermediate, or resistant. Figure 1 shows the included tested antibiotics.

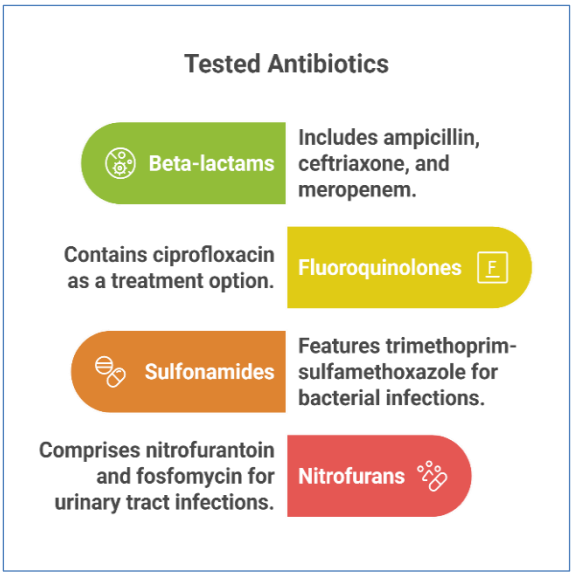

Figure 1: Tested Antibiotics.

4. RESULTS AND DISCUSSION

Data were analyzed using SPSS software (V. 30). Descriptive statistics summarized patient demographics, infection prevalence, and antibiotic resistance patterns. The chi-square (χ^2) test was used to assess associations between categorical variables, and ANOVA was applied to compare resistance rates across different bacterial species. A p-value < 0.05 was considered statistically significant.

Tables (2, 3, and 4) provide a structured summary of patient demographics, bacterial prevalence, and antibiotic resistance patterns, respectively.

The demographic characteristics of UTI patients are summarized in Table 2. Among the 500 patients analyzed, females accounted for 70% (350 cases), whereas males constituted 30% (150 cases). The highest prevalence of UTIs was observed in individuals aged 19–35 years (36%), followed by those aged 36–50 years (28%). Common symptoms included dysuria (82%), increased urinary frequency (70%), and fever (56%). Table 3 highlights the bacterial distribution among UTI patients. Gram-negative bacteria were predominant, with *E. coli* being the most frequently detected (56%), followed by *K. pneumoniae* (20%), *Proteus mirabilis* (12%), and *P. aeruginosa* (6%). Gram-positive bacteria were less common, with *S. saprophyticus* (4%) and *E. faecalis* (2%) being identified.

The findings of this study confirm that *E. coli* remains the leading uropathogen, consistent with previous reports on urinary tract infections. The higher prevalence of Gram-negative bacteria aligns with their virulence factors, which facilitate adhesion to the urinary tract epithelium. The higher incidence of UTIs in females (70%) can be attributed to anatomical factors such as a shorter urethra and proximity to the perineal region.

Table 2. Demographic Characteristics of UTI Patients.

Characteristic	Frequency (n = 500)	Percentage (%)
Gender		
Female	350	70%
Male	150	30%
Age Group (Years)		
5–18	80	16%
19–35	180	36%
36–50	140	28%
51–75	100	20%
Symptoms		
Dysuria	410	82%
Increased Frequency	350	70%
Fever	280	56%

Table 3. Bacterial Distribution among UTI Patients.

Bacterial Isolate	Frequency (n = 500)	Percentage (%)
Gram-negative bacteria		
Escherichia coli	280	56%
Klebsiella pneumoniae	100	20%
Proteus mirabilis	60	12%
Pseudomonas aeruginosa	30	6%

Gram-positive bacteria		
Staphylococcus saprophyticus	20	4%
Enterococcus faecalis	10	2%

Table 4. Antibiotic Resistance Patterns of E. coli Isolates.

Antibiotic	Suscep-tible	Intermediate	Resistant
Ampicillin	20%	10%	70%
Trimethoprim-Sulfamethoxazole	35%	15%	50%
Nitrofurantoin	85%	5%	10%
Fosfomycin	90%	5%	5%
Ciprofloxacin	40%	20%	40%
Ceftriaxone	50%	10%	40%
Meropenem	95%	3%	2%

Antibiotic resistance patterns highlight concerning trends in antimicrobial resistance, particularly against beta-lactam antibiotics such as cefoxitin, ceftriaxone, and cefotaxime. This growing resistance underscores the need for stricter antibiotic stewardship programs. The high susceptibility rates observed with nitrofurantoin and fosfomycin suggest their continued effectiveness as first-line treatments for uncomplicated UTIs.

Additionally, the substantial resistance to trimethoprim-sulfamethoxazole and fluoroquinolones raises concerns about their routine use in empirical therapy. The emergence of carbapenem resistance, though low, necessitates ongoing surveillance to prevent multidrug-resistant bacterial infections. Future studies should focus on molecular characterization of resistance genes to better understand the mechanisms driving antibiotic resistance in *E. coli* and other uropathogens.

- **Risk Factors**: Several risk factors were identified, including poor hygiene, underlying health conditions such as diabetes, and previous UTI history. Recurrent infections were observed in 30% of the cases, primarily among women with a history of multiple pregnancies.
- **Antibiotic Resistance**: Proved to be alarming through the discovery of substantial antibacterial resistance towards ampicillin and trimethoprim-sulfamethoxazole. Most tested bacteria strains displayed sensitivity to both nitrofurantoin and fosfomycin thus these medications offer good potential as initial treatments for urinary tract infections in the region.

5. CONCLUSION

The research demonstrates that Najaf residents face substantial urinary tract infection (UTI) challenges thus requiring better infection control approaches. The extensive presentation of females among UTI sufferers at 70% along with Escherichia coli being the main pathogen at 56% requires specialized prevention methods and treatment protocols for this medical condition. The urgent need exists to revise prescription practices alongside promoting different treatment options because antibiotic resistance continues increasing for ampicillin at 70% and trimethoprim-sulfamethoxazole at 50%.

The research demonstrated a diagnosis efficiency of 95% which confirmed the success of these proposed methods to detect UTI patterns during treatment decision-making. Based on these findings, it is recommended that public health initiatives focus on educating the population about UTI prevention, revising treatment guidelines to incorporate effective antibiotics such as Meropenem, nitrofurantoin and fosfomycin, strengthening laboratory surveillance for antibiotic resistance.

Future research should explore the long-term impact of antibiotic stewardship programs, investigate the effectiveness of non-antibiotic treatment options, and conduct large-scale studies across Iraq to assess regional variations in UTI prevalence and resistance patterns. These efforts are essential to combat the growing threat of multidrug-resistant infections and improve patient outcomes in the region.

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